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REVOLVING VANE MECHANISM: A NOVEL PUMPING MECHANISM

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Special Presentation (Case Study)

Revolving Vane Mechanism: A Novel Pumping Mechanism

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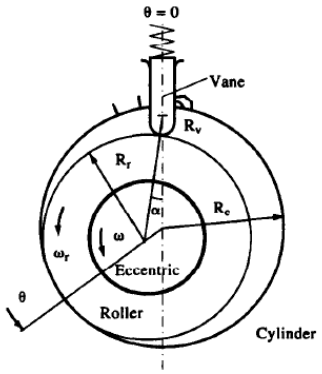
ABSTRACT

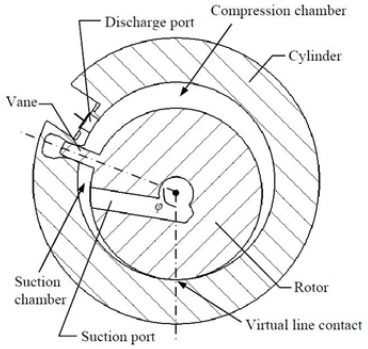
One of the most successful rotary mechanisms widely used in today's compressors and pumps is the rolling piston mechanism. In its basic form, the rolling piston mechanism comprises of five components: a roller, a cylinder, a vane, an eccentric and a discharge valve. During operation, the roller rolls around the inner wall of the cylinder and maintains the contact with the inner cylinder wall, during which the vane tip maintains the contact with the roller by rubbing over the external surface of the roller. It is a quiet machine, simple to manufacture and with low vibrations as compared to a reciprocating machine. However it is not without disadvantages. Because of its construction, there are six rubbing regions and which cause significant frictional losses. These are

(i) eccentric and inner surface of the roller,
(ii) roller and cylinder end-faces,
(iii) eccentric and cylinder end-faces,
(iv) outer surface of roller and inner surface of cylinder,
(v) vane side and vane slot, and
(vi) vane tip and roller.



Additionally, the eccentric and roller are not rotating about their own axes but orbiting about the central axis of the cylinder. This results in unnecessary vibration and wobbling during operation. Lastly, as the vane tip has to rub against the outer surface of the roller, the components are easily weakened, and wear and tear are inevitable.

In order to overcome the above mentioned weaknesses of the rolling mechanism, the **revolving vane mechanism** is introduced. The following modifications are proposed:



1. Combine eccentric and roller into a single component called a rotor to eliminate the rubbing between the eccentric and the inner surface of the roller.
2. Make both the rotor and cylinder (and its end-faces) to rotate eccentrically with respect to each other to minimize the relative rubbing velocity which reduces the end-face frictional losses. In addition, since the rotor spins about its own axis, the unwanted vibration and wobbling effects from the orbiting motion of both eccentric and roller are eliminated.
3. Attach the vane onto the rotor as a single component and have it rotated together with the rotor. This eliminates the rubbing at vane tip and, most importantly, it also removes the dependency of the vane side-slot friction on the pressure differential across the vane.
4. Modify the vane slot to minimise the frictional loss at vane side and vane slot.

As compared to the rolling piston mechanism, the novel mechanism shows great potential in improving the frictional losses, lower vibration, simpler manufacturing process, and without critical component such as that caused by the vane tip. In the presentation, similarity and differences between the two mechanisms will be presented; simulation and animation results will also be shown comparing rolling piston and revolving vane as compressing mechanisms.